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TITLE A CAMAC SYSTEM CONTROLLED BY AN IBM AT COMPUTER FOR TIME-RESOLVED SPECTROSCOPY

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A CAMAC SYSTEM CONTROLLED BY AN IBM AT COMPUTER FOR TIME-RESOLVED SPECTROSCOPY

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Abstract

An IBM AT computer interfaced to a small CAMAC system offers considerable power without the complexity and expense of a large general-purpose system. Our system for time-resolved spectroscopy features menu-driven FORTRAN-based software; high-resolution and high-speed (8K channels, 5-μs fixed dead time) ADCs; segmentable histogram memories (24-bit counts) with large memory space for many histogram segments; independently variable separate histogram dwell times; remote control via a CAMAC serial highway; and ground isolation between the data acquisition equipment and control computer by means of fiber optics.

Introduction

Traditionally, gamma-ray time-resolved spectroscopy has been done with hard-wire multichannel analyzers or a sophisticated special purpose computer system. With an analyzer, the amount of memory available (usually 16K) may be a severe constraint. Alternatively, in list mode the counting rate may be limited. Recently, buffered ADCs connected to personal computers have become available,[1] but they are not well suited for time-resolved spectroscopy.

Hardware

We chose a simple CAMAC system interfaced to an IBM AT computer. Figure 1 shows a block diagram of the overall implementation, and Figs. 2 and 3 show the hardware. The complete system including the computer fits into five one-man portable shipping cases. The interface to the computer is via an interface card that fits into an 8/16-bit slot of the IBM AT and is connected by a 50-line ribbon cable to a general-purpose crate controller in the local crate. The local crate can be operated at 8400 CAMAC 24-bit read or write instructions per second with this particular software and IBM AT 6-Mhz implementation. Because of radiation hazards, there is a link from the local crate to a remote crate via an IEEE 595 CAMAC serial highway operating at up to 5 Mbyte/s. The remote crates can be operated at 1200 CAMAC 24-bit read or write instructions per second. This is not the ultimate operational speed of the CAMAC serial highway hardware, but rather the present limit of the software and computer hardware used.

The link to the remote crates is driven by a CAMAC serial highway driver located in the local crate and an associated U(undefined)-port adapter for that serial highway driver module. A U-port adapter link that incorporates fiber optics is available for the serial highway driver to avoid ground loops which might cause significant degradation of the system's energy resolution when germanium detectors are used.

All data acquisition equipment is installed in the remote crate, which is controlled by a CAMAC serial highway crate controller that is attached to another U-port adapter. As many as 62 crates for data acquisition equipment may be simultaneously connected to the serial highway with no constraints attached to the type of CAMAC modules installed in each of the crates.

The data are sensed and acquired into an 8K(13-bit) ADC and routed into eight 16K histogram memory modules under the control of a data router. The ADC may be set for less than 8K data acquisition in powers of 2 (250, 500, 1000, 2000, or 4000 channels). The histogram memory may also be segmented into less than 8K segments so that no memory space is wasted when the ADC is set up for less than 8K resolving power. Thus the memory modules that can accommodate sixteen 8K spectras can also accommodate thirty-two 4K spectras, sixty-four 2K spectra, etc. Several clocks to actuate the data router (including one within the data router) are available to set the widths of the time bins. The bins of time that the router will put data into the corresponding histogram memory segments may be equal or divided into groups with three different widths (a three-speed clock implementation); they may increase in binary steps or logarithmically. Steps are being taken to test a new clock implementation that will provide even more timing flexibility.

Software

The software for the system is a menu-driven design with FORTRAN as the primary language. By using the menu, all of the module parameters may be selected, stored, and retrieved. For example, the number of channels in each spectrum and the dwell times may be selected. The data acquisition may be programmed to start as soon as enabled or to start

when an external start signal is received. At the completion of a measurement, the data are transferred to hard or floppy disk as directed by the operator; 128K of histogram dat require about 6 minutes to transfer from the histogram memories to the hard disk (30-ms access time for the 6-Mhz IBM AT). The storage format on the disk files for this data is directly compatible and readable by MAESTRO (supplied by EG&G ORTEC), which is one of the data analysis programs that we routinely use.

Applications

We required the capability offered by this hardware and software for three applications:

1. studying the decay of fission products produced by bremsstrahlung pulses from a linac,[2]

2. studying the fission products produced by an intense neutron pulse from a burst reactor,[3] and

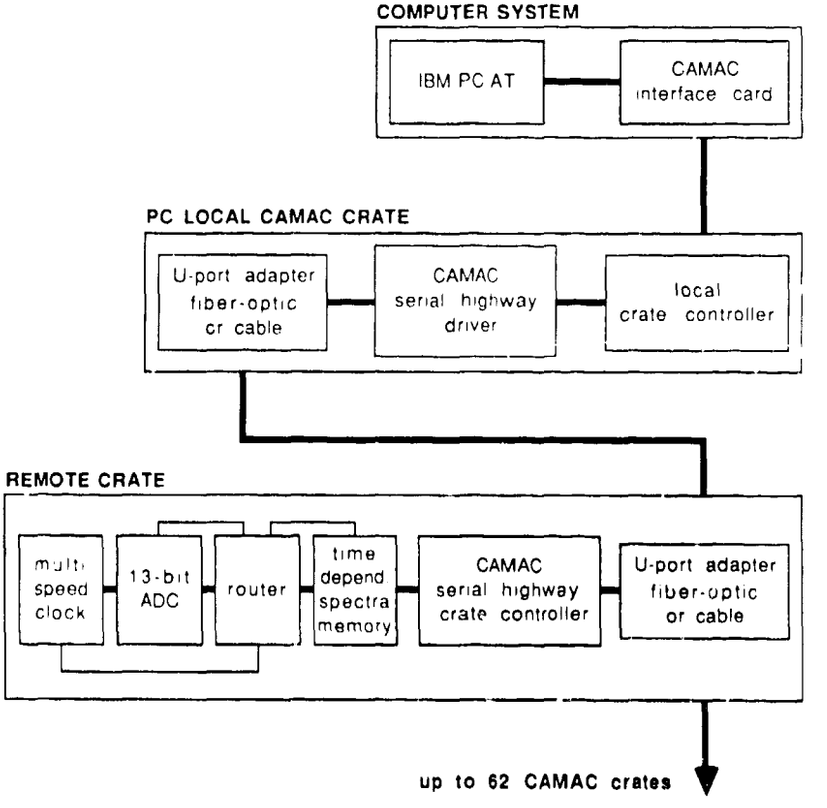

Fig. 1. Time-resolved spectroscopy system using an IBM AT computer and CAMAC modules with IEEE 595 serial highway technology.

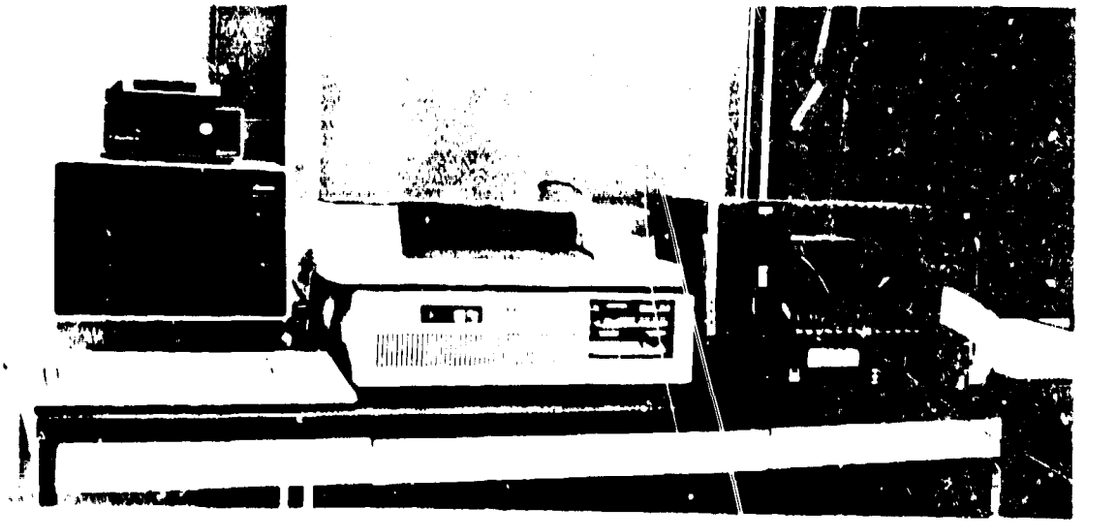

Fig. 2. Local system including an IBM AT computer and a CAMAC crate. The ribbon cable at the right connects to an interface card in the computer. The cable from the U-port adapter in the crate goes to the remote crate. A plotter is on top of the central processor unit in the center.

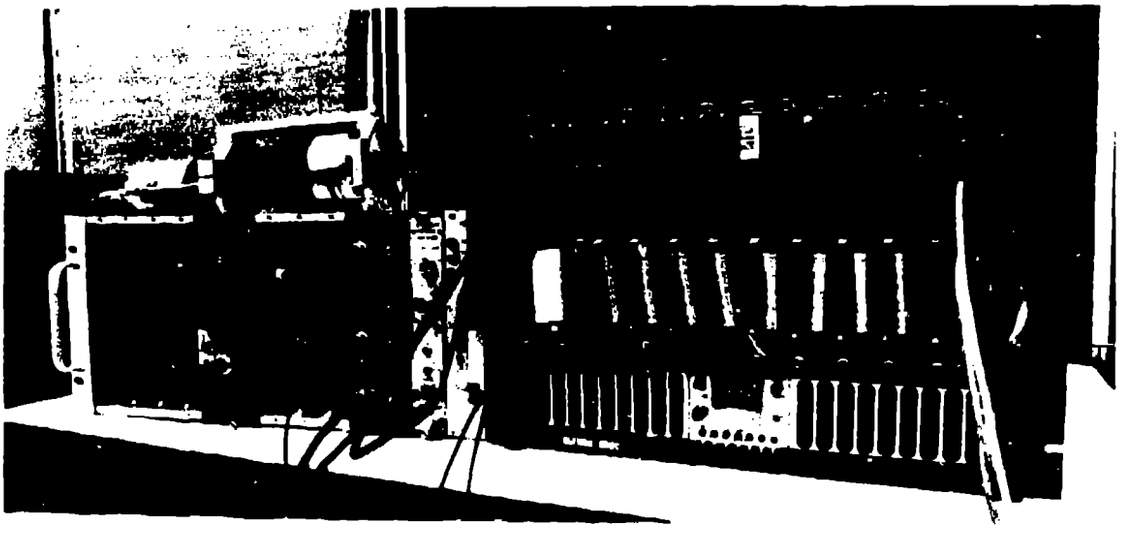

Fig. 3. Remote system. The CAMAC crate contains a three-speed clock, ADC, data router, eight histogram memory modules, a U-port adapter, and a serial highway crate controller. The NIM bin contains electronics for the bismuth germanate scintillator on top. Many applications require a germanium detector. The cable at the right on the U-port adapter goes to the local crate.

3. investigating the detector response when a radioactive source is moved past a detector to assist in the design of better vehicle monitors.

Conclusions

Our specific applications are in time-resolved spectroscopy, but the software drivers and these ideas may be used with any CAMAC system. Because more than 600 kinds of CAMAC modules are available, many applications are possible. IBM AT and compatible computers are very familiar to most people and are very inexpensive with respect to their capabilities. The combination of an IBM AT computer and a small CAMAC system offers considerable power without the complexity and expense of a large general-purpose system.

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John Caldwell and George Auchampaugh provided financial support. John Pratt and Tom Kuckertz provided consultation during the early stages of this work.

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